

C L A I M S

What is claimed is:

- 1 1. A system for directly measuring a magnetostriction
2 value of a magnetoresistive element, the system
3 comprising:
4 a fixture for receiving a substrate carrying one or
5 more magnetoresistive elements;
6 a magnet assembly for applying a first magnetic field
7 parallel to the substrate, and for applying a
8 magnetic alternating field perpendicular to the
9 substrate and parallel to magnetoresistive layers
10 of the elements;
11 a mechanism for applying a mechanical stress to the
12 substrate, the stress being oriented parallel to
13 the substrate; and
14 a measuring subsystem for measuring a signal from at
15 least one of the magnetoresistive elements.
- 1 2. A system according to claim 1, wherein the substrate
2 is a row or a wafer.
- 1 3. A system according to claim 2, wherein the row or
2 wafer carries a plurality of the magnetoresistive
3 elements.
- 1 4. A system according to claim 1, wherein the first
2 magnetic field is a DC field.

- 1 5. A system according to claim 1, wherein the measuring
2 subsystem is locked to a frequency of the alternating
3 field.
- 1 6. A system according to claim 1, wherein the signal from
2 the at least one of the magnetoresistive elements is
3 measured before the mechanical stress is applied;
4 wherein, after applying the mechanical stress, the
5 first magnetic field is changed until the signal being
6 measured co-currently thereto about matches the signal
7 measured before applying the mechanical stress.
- 1 7. A system according to claim 1, wherein the mechanism
2 for applying the mechanical stress causes the
3 substrate to bend.
- 1 8. A system according to claim 7, wherein the mechanism
2 for applying the mechanical stress is a micrometer
3 screw.
- 1 9. A system according to claim 8, wherein the micrometer
2 screw is electronically controlled.
- 1 10. A system according to claim 1, wherein the mechanism
2 for applying the mechanical stress is a heat source.
- 1 11. A system according to claim 1, wherein the mechanism
2 for applying the mechanical stress is a piezo layer.
- 1 12. A system according to claim 1, further comprising a
2 controller for changing the first magnetic field.

- 1 13. A system according to claim 12, further comprising a
2 computing device for calculating a magnetostriction
3 constant of the at least one magnetoresistive element
4 based in part on a change of mechanical stress
5 anisotropy due to application of the mechanical stress
6 and the change in the first magnetic field.
- 1 14. A system according to claim 1, wherein the at least
2 one magnetoresistive element includes shielding
3 layers, wherein the first magnetic field is calibrated
4 to reflect an influence of a demagnetizing effect of
5 the shielding layers on the element.
- 1 15. A system according to claim 1, wherein the
2 magnetoresistive element is an Anisotropic
3 Magnetoresistance (AMR)-, Giant Magnetoresistance
4 (GMR)- or Tunneling Magnetoresistance (TMR)-based
5 sensor.
- 1 16. A system according to claim 1, wherein the
2 magnetoresistive elements are magnetic memory
3 elements.
- 1 17. A system for directly measuring a magnetostriction
2 value of a magnetoresistive element, the system
3 comprising:
4 a bending fixture for receiving a substrate carrying
5 one or more magnetoresistive elements;
6 a magnet assembly for applying a magnetic direct
7 current (DC) field parallel to the substrate, and

8 for applying a magnetic alternating field
9 perpendicular to the substrate and parallel to
10 magnetoresistive layers of the elements;
11 a mechanism for applying a mechanical stress to the
12 substrate by bending the substrate, the stress
13 being oriented parallel to the substrate;
14 a control circuit for changing the DC magnetic field;
15 and
16 a measuring subsystem for measuring a signal from at
17 least one of the magnetoresistive elements prior
18 to application of the mechanical stress, after
19 application of the mechanical stress, and during
20 a time period when the DC magnetic field is
21 changed.

1 18. A system for directly measuring a magnetostriction
2 value of a magnetoresistive element, the system
3 comprising:
4 a bending fixture for receiving a substrate carrying
5 one or more magnetoresistive elements;
6 a magnet assembly for applying a magnetic direct
7 current (DC) field parallel to the substrate, and
8 for applying a magnetic alternating field
9 perpendicular to the substrate and parallel to
10 magnetoresistive layers of the elements;
11 a DC power supply for providing power to the magnet
12 assembly;
13 an alternating current (AC) power supply for providing
14 power to the magnet assembly;

15 a mechanism for applying a mechanical stress to the
16 substrate by bending the substrate, the stress
17 being oriented parallel to the substrate;
18 a measuring subsystem for measuring a signal from at
19 least one of the magnetoresistive elements prior
20 to application of the mechanical stress, after
21 application of the mechanical stress, and during
22 a time period when the DC magnetic field is
23 changed;
24 a control circuit for changing the DC magnetic field
25 until the signal currently being measured by the
26 measuring subsystem about matches a signal
27 measured before applying the mechanical stress;
28 and
29 a computing device for calculating a magnetostriction
30 constant of the at least one magnetoresistive
31 element based in part on a change of mechanical
32 stress anisotropy due to application of the
33 mechanical stress and the change in the DC
34 magnetic field.

1 19. A method for directly measuring a magnetostriction
2 value of a magnetoresistive element, the method
3 comprising:
4 providing a substrate carrying one or more
5 magnetoresistive elements;
6 placing the substrate on a fixture;
7 applying a first magnetic field parallel to the
8 substrate;

9 applying a magnetic alternating field perpendicular to
10 the substrate and parallel to magnetoresistive
11 layers of the elements;
12 measuring a signal from the element;
13 applying a mechanical stress to the substrate, the
14 stress being oriented parallel to the substrate;
15 and
16 changing the first magnetic field until the signal
17 currently being measured about matches a signal
18 measured before applying the mechanical stress.

1 20. A method according to claim 19, wherein the substrate
2 is a row or a wafer.

1 21. A method according to claim 20, wherein the row or
2 wafer carries a plurality of the magnetoresistive
3 elements.

1 22. A system according to claim 19, wherein the mechanical
2 stress causes the substrate to bend.

1 23. A method according to claim 22, wherein the mechanical
2 stress is applied by a micrometer screw.

1 24. A method according to claim 19, wherein the
2 magnetoresistive element is an Anisotropic
3 Magnetoresistance (AMR)-, Giant Magnetoresistance
4 (GMR)- or Tunneling Magnetoresistance (TMR)-based
5 sensor.

1 25. A method for directly measuring a magnetostriction
2 value of a magnetoresistive element, the method
3 comprising:
4 providing a substrate carrying one or more
5 magnetoresistive elements;
6 placing the substrate on a bending fixture;
7 applying a magnetic DC field parallel to the
8 substrate;
9 applying a magnetic alternating field perpendicular to
10 the substrate and parallel to magnetoresistive
11 layers of the elements;
12 measuring a signal from at least one element;
13 applying a mechanical stress to the substrate by
14 bending the substrate, the stress being oriented
15 parallel to the substrate;
16 changing the magnetic DC field until the signal
17 currently being measured about matches a signal
18 measured before applying the mechanical stress;
19 and
20 calculating a magnetostriction value of the element.